INSTRUCTION MANUAL

EMPIRE*

CLAMP-ON-PROBE

MODEL CP-105

Gertsch*
EMPIRE*
Sensitive Research*
Panoramic*
SINGER

*A Trademark of THE SINGER COMPANY

Precision electrical and electronic instruments for measurement

THE SINGER COMPANY • METRICS DIVISION

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Name.....

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Models:..... Serial No. .....

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Date..... CONDITION ON ARRIVAL.....

FIELDS OF APPLICATION:.....

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COMMENTS: .....

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WARRANTY

THE SINGER COMPANY, METRICS DIVISION, warrants each new instrument to be free from defects in material and workmanship, effective after delivery to the original purchaser as follows:

*Commander** Instruments: Potentiometers, Bridges,
Volt Ratio Boxes and Standard Resistors.....5 years
*Sensitive Research** Electrical Indicating Instruments.....2 years
Other Electrical and Electronic Measuring Instruments.....1 year

Repair or replacement (at our option) without charge (F.O.B. factory) will be effected when our examination satisfactorily indicates that defects are due to workmanship or materials. Electron tubes, semiconductors, batteries, fuzes, lamps, thermoelements, and *RatioTran** potentiometers are excluded from warranty coverage. Warranty returns must first be authorized by the factory.

If the instrument or any portion thereof, has been abused, misused, damaged by accident or negligence, or if any serial number or seal has been removed or altered, the warranty is void.

This warranty is in lieu of all other obligations or liabilities expressed or implied and The Singer Company neither assumes, nor authorizes any person to assume for them, any other liability in connection with sales of instruments manufactured by The Singer Company, Metrics Division.

THE SINGER COMPANY • METRICS DIVISION
915 PEMBROKE STREET, BRIDGEPORT, CONNECTICUT • 3211 S. LA CIENEGA BLVD., LOS ANGELES, CALIFORNIA

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REPAIR AND MAINTENANCE

Instruments should be returned only on prior written authorization from the Singer Representative or the factory(1). Warranty repair will be made upon written request. Please provide the following information in order to expedite our processing of your instrument:

1. Model or Type
2. Serial Number
3. Description of trouble(2)
4. Test instruments used
5. Approximate date instrument was placed in operation
6. Approximate number of hours of use
7. Has maintenance action been previously requested?
8. Other comments

Upon receipt of this information our Service Department will send you service data or shipping instructions. Upon receipt of shipping instructions forward the instrument to the factory prepaid. If requested, an estimate of charges will be made before work begins.

(1) Contact Metrics Division, Bridgeport, Connecticut for *Commander**, *Empire**, *Panoramic**, and *Sensitive Research** instruments. Contact Metrics Division, Los Angeles, California for *Gertsch** instruments.

(2) Include data on symptoms, measurements taken, suspected location of trouble, maintenance action taken, and any other relevant data.

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INTRODUCTION

Clamp-on Probe, Model CP-105 is a split-core, inserted-primary type RF current transformer. It is designed for use in conjunction with Models NF-105 and NF-205 Noise and Field Intensity Meters and other equipments having an input impedance of 50 ohms. It permits the measurement of RF currents flowing in conductors or groups of conductors having diameters up to 1-1/4 inches without physically disturbing them. Large power line currents and high voltages have no effect on measurement accuracy. The frequency range is 14 KC to 100 MC. At frequencies from 150 KC to 30 MC, RF currents may be read directly without the use of charts; from 14 KC to 150 KC, currents may be read by referring to fig. 2.

Characteristics:

Frequency Range - 14 KC to 100 MC

RF Current Range - 0 to 1 ampere

Transfer Admittance - 1.0 (+10% -25%) from 150 KC to 30 MC

(See fig. 2) from 14 KC to 150 KC

Load Impedance - 50 Ω nominal

Maximum Power Current - 350 amperes DC to 1500 CPS

Maximum Power Voltage - limited by conductor insulation

Output Connector - type BNC female

Dimensions - see outline drawing fig. 1

Weight - 15 ounces

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Transfer Admittance - 1.0 (±10% -3%) from 150 KC to 30 MC

(See fig. 2) from 14 KC to 150 KC

Load Impedance - 50Ω nominal

Maximum Power Current - 350 amperes DC to 1500 CPS

Maximum Power Voltage - limited by conductor insulation

Output Connector - type BNC female

Dimensions - see outline drawing fig. 1

Weight - 15 ounces

THEORY

The Clamp-on Probe is an RF current transformer, the primary winding being formed by the conductor under test and a return path such as the equipment frame or a ground plane. Therefore the primary can be considered as having a single turn when the conductor under test passes once through the probe's window. When many conductors pass through the window, the current indicated is the algebraic sum of all the currents in the conductors. If an over-all shield braid is used or if a coaxial cable is measured, the indicated current will be that flowing on the outer surface of the shield.

The transformer's core is split into two identical hinged halves. When the halves are closed, insulating material separates the butted ends increasing the core's saturation level. A spring hasp is used to insure that the halves always butt in the same manner.

The primary current (I_p) is related to the secondary voltage (E_s) by the following Equation: $$I_p = \frac{(E_s)\ (Y_t)}{N}$$

where: I_p = RF current flowing in primary

E_s = secondary voltage developed across a 50 Ω load.

N = number of times primary passes through the probe window (normally one).

Y_t = transfer admittance

It can be seen from this equation that the probe's sensitivity can be increased by looping the primary several times through the core. The primary impedance is increased by this method and the measurement accuracy is reduced.

THEORY

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The transformer's core is split into two identical hinged halves. When the halves are closed, conducting material separates the butted ends increasing the core's saturation level. A spring bias is used to insure that the halves always bolt in the same position.

The primary current (I_p) is related to the secondary voltage (E_s) by the following Equation: $I_p = \frac{(E_s)\ (Y_t)}{N}$

where: I_p = RF current flowing in primary

E_s = secondary voltage developed across a 50 Ω load.

N = number of times primary passes through the probe window (normally one).

Y_t = transfer admittance

It can be seen from this equation that the probe's sensitivity can be increased by looping the primary several times through the core. The primary impedance is increased by this method and the measurement accuracy is reduced.

OPERATION

Spring back the hasp to open the probe and place it around the conductor or conductors to be measured. Close the probe firmly until the hasp snaps shut.

Do not permit the probe to touch the metal parts of any equipment, shield braid or the ground plane as ground loops formed in this manner will affect measurement accuracy. Care should also be exercised to maintain sufficient insulation between high voltage conductors and the probe's case.

Often standing waves will exist along the measured conductor. A true measure of the current flowing can only be made by taking readings at intervals along the conductor.

At frequencies above 25 MC, the measurement accuracy will be improved when the conductor under measurement is centered within the opening in the probe's window.

NARROW BAND MEASUREMENTS

1. Calibrate the NF-105 or NF-205 as a two-terminal RF voltmeter as outlined in its instruction book.
2. Connect the current probe.
   a. Between 150 KC and 30 MC the transfer admittance (Y_t) equals one. Therefore the equipment will indicate directly in microamperes or in DB above one microampere instead of microvolts or in DB above one microvolt. (ie; 100 uv indicated means 100 ua is flowing in the conductor being measured.)

b. Between 14 KC and 150 KC the transfer admittance read from the chart (fig. 2) should be used to multiply the meter reading in microvolts or added to the reading in DB above one microvolt.

Example

Frequency = 20 KC

Meter Reading = 1000 uv = 60 DB above 1 uv

From fig. 2:

Y_t = 2.9 MHOS = 9.2 DB above one MHO

Therefore:

$I_p = (1000)\ (2.9) = 2900$ ua

or $I_p = 60 + 9.2 = 69.2$ DB above 1 ua

BROADBAND MEASUREMENTS

These measurements should be made by the substitution method as outlined in the instruction book for the NF-105 or NF-205.

Between 150 KC and 30 MC the meter reading in DB above one microvolt per megacycle may be converted directly into DB above one microampere per megacycle. (ie; 50 DBMC indicated means 50 DB above one microampere per megacycle is flowing in the conductor being measured.)

Between 14 KC and 150 KC the transfer admittance should be read from the chart (fig. 2) and added to the meter reading.

Example

Frequency = 20 KC

Meter Reading = 80 DBMC

From fig. 2:

Y_t = 9.2 DB above one MHO

$\therefore I_p$ = 89.2 DB above one microampere per megacycle.

MEASUREMENTS BELOW 14 KC

Figure 3 shows the transfer admittance for the frequency range of 100 CPS to 100 KC. It applies to both narrowband and broadband measurements. For all frequencies below 14 KC, the slope is 6 DB per octave of frequency or 20 DB per decade of frequency. The rate of slope enables the admittance curve to be extrapolated down to 20 CPS.

Y_t at 20 CPS = 69 DB above one MHO

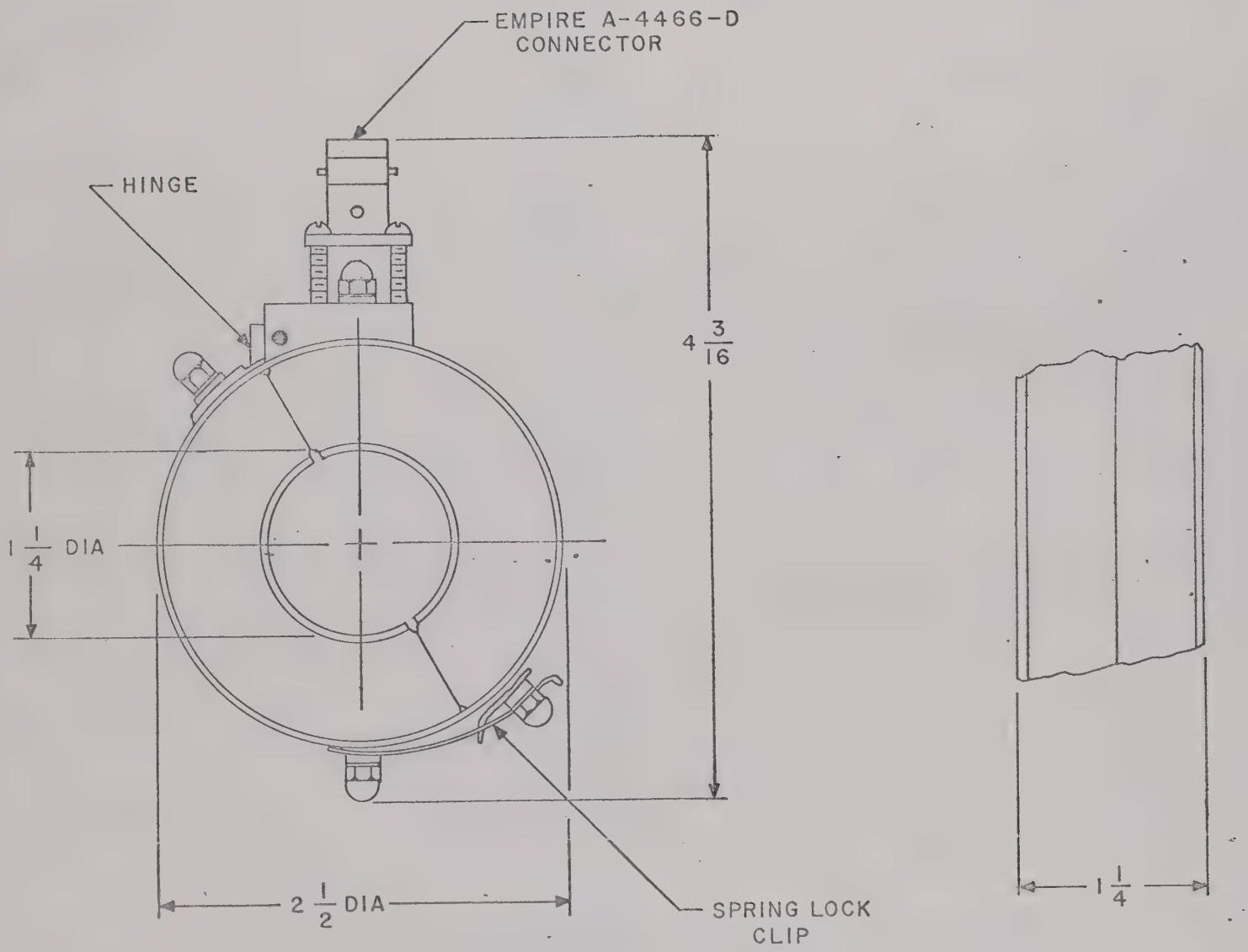

FIGURE I. OUTLINE DRAWING, CP-105

NO. 340 -L220 DIETZGEN GRAPH PAPER
SEMI-LOGARITHMIC
2 CYCLES X 20 DIVISIONS PER INCH

EUGENE DIETZGEN CO.
MADE IN U. S. A.

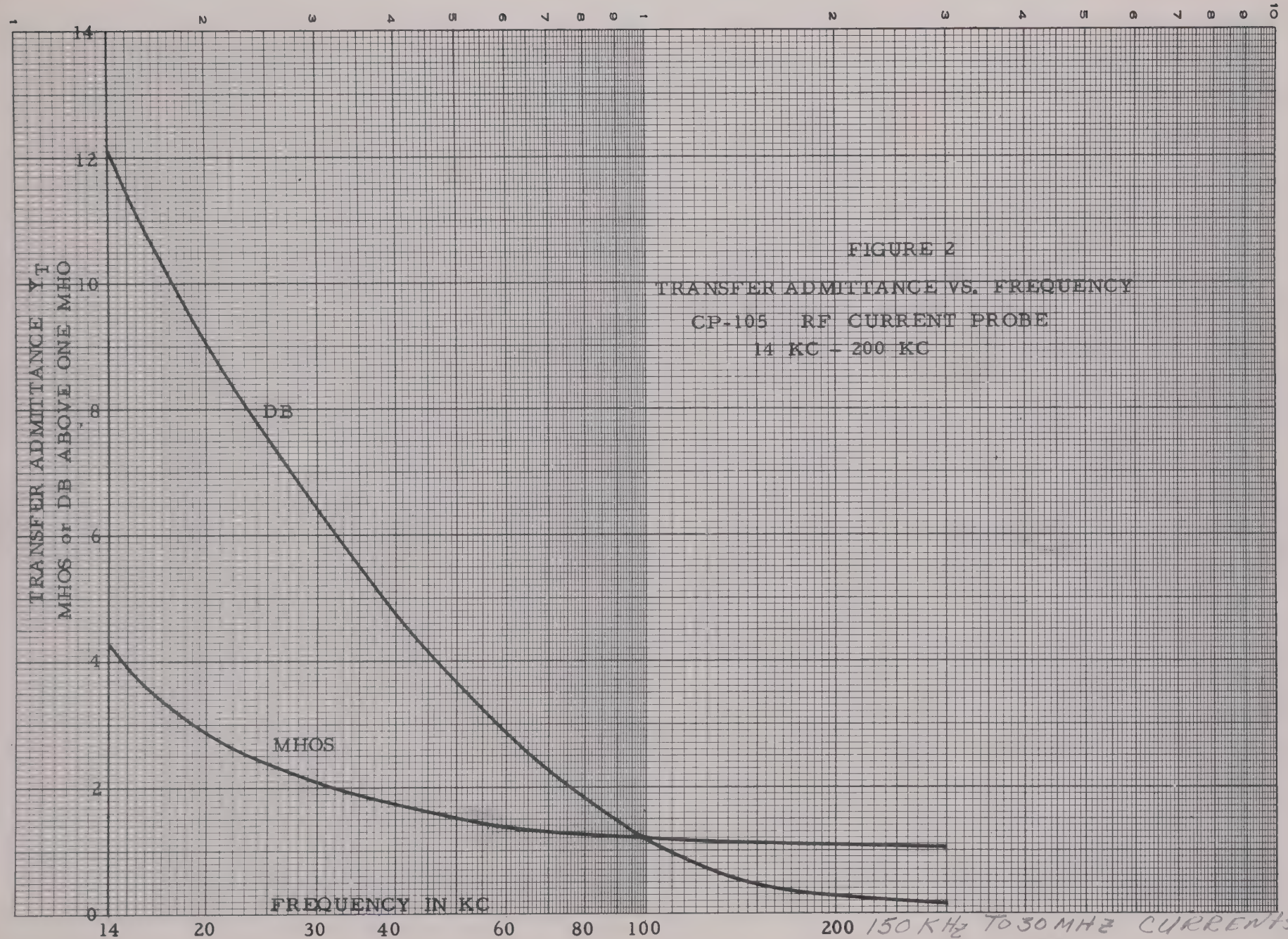

FIGURE 2

TRANSFER ADMITTANCE VS. FREQUENCY

CP-105 RF CURRENT PROBE

14 KC - 200 KC

150 KHz To 30 MHz CURRENTS MAY Be Read directly —

K+E SEMI-LOGARITHMIC 359-71
KEUFFEL & ESSER CO. MADE IN U.S.A.
3 CYCLES X 70 DIVISIONS

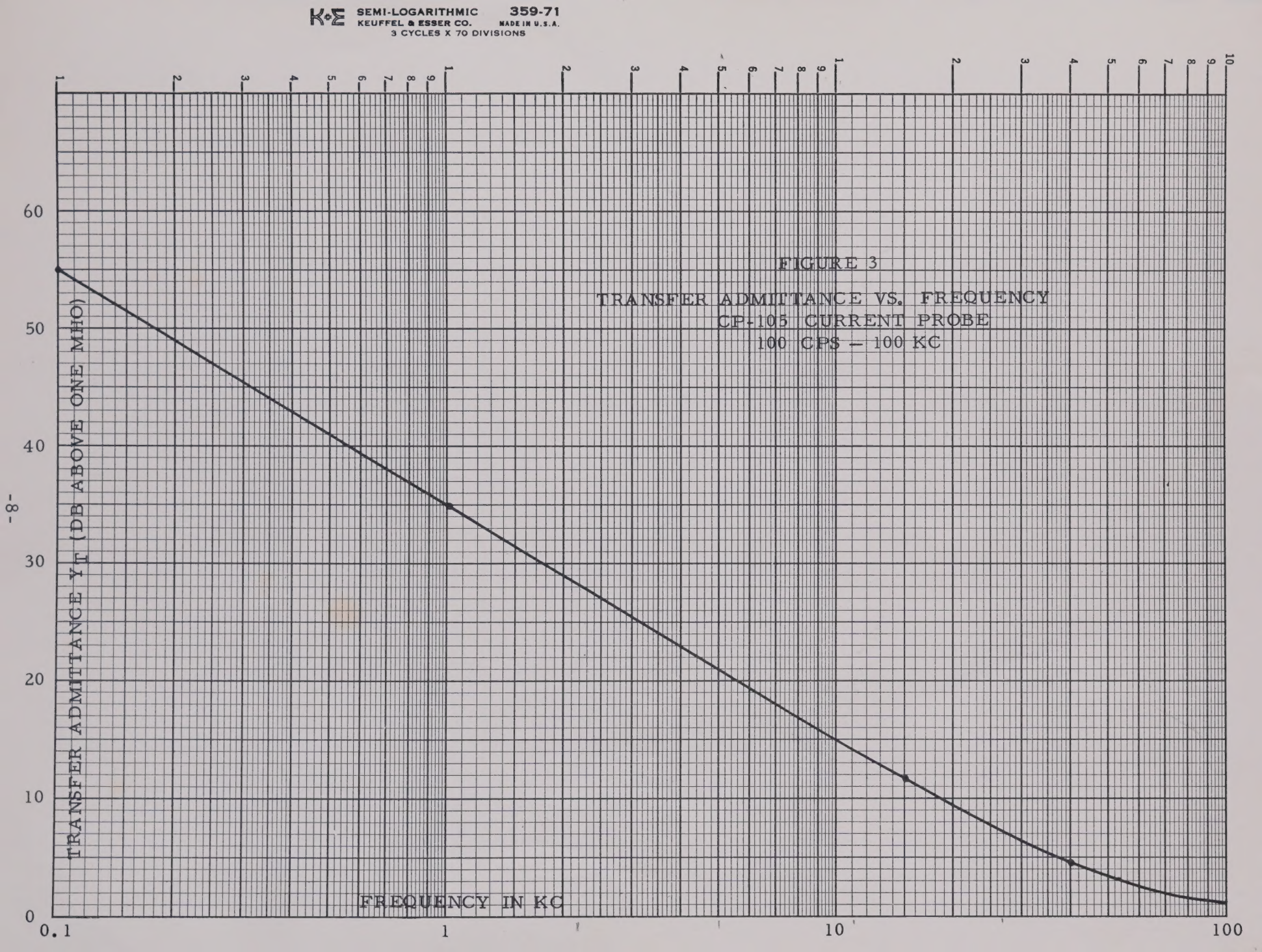

FIGURE 3
TRANSFER ADMITTANCE VS. FREQUENCY
CP-105 CURRENT PROBE
100 CPS – 100 KC